



*Optimal Solutions for the Future*

# **FM *linear* series**



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**Ultra-high-speed,  
High-precision  
Vertical Machining  
Center Equipped  
with Linear Motors**

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## **FM *linear* series**

FM 200/5AX *linear*

FM 350/5AX *linear*

FM 400 *linear*

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ver. EN 150706 SU



reddot award 2015  
winner

Basic Information

Basic Structure  
Travel Axis

Detailed  
Information

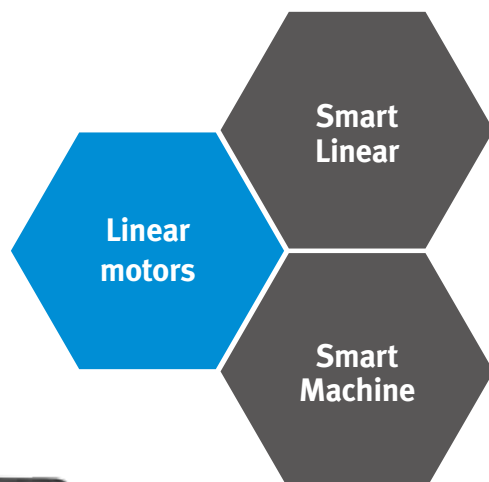
Options  
Capacity Diagram  
Specifications

Customer Support  
Service



# FM *linear* series

The FM Linear Series offers super-fast traveling and great reliability with its high-speed spindle and linear axes driven by linear motors, in addition to excellent stability in cutting operation due to the adoption of anti-vibration materials.



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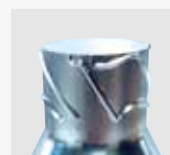
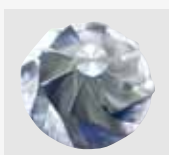
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### Sample work



### Stable bed and structure design

Stable cutting based on anti-vibration materials and symmetrical gantry structure.

### Stable cutting based on anti-vibration materials and symmetrical gantry structure.

Outstanding productivity and cutting accuracy are delivered with 40,000 rpm spindles, linear motors, and direct-drive motors.

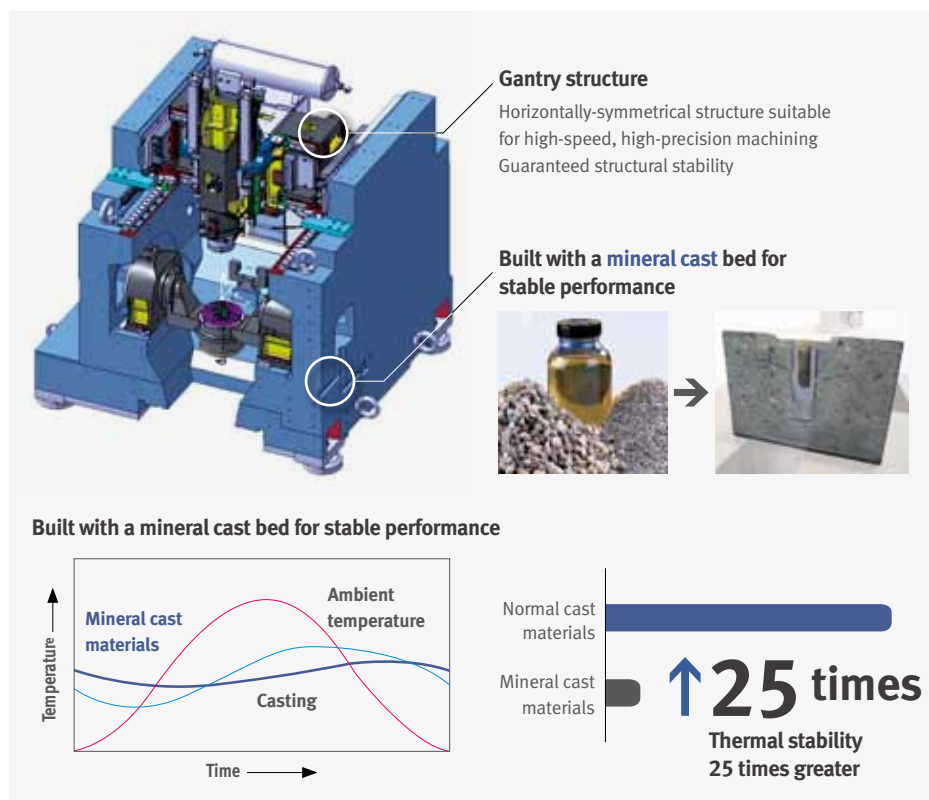
### Heidenhain controller for maximum reliability

The adoption of Heidenhain controllers optimized for high-speed processing enhances machine reliability, visibility, and display applicability.

## Basic Structure

Stable cutting based on symmetrical gantry structure and anti-vibration materials (mineral casting).

## Structural and Material Features



## Axis System

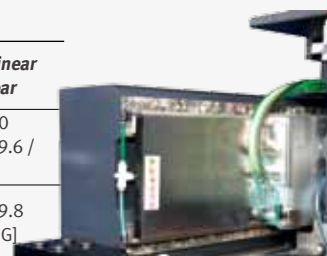
The linear axes and rotary axes deliver high speed and superior accuracy.

## Linear Axes Equipped with Linear Motors

The X / Y / Z linear axes are driven by linear motors to realize high speed and accuracy, as well as superior positioning and repeatability.

Up to **2G**

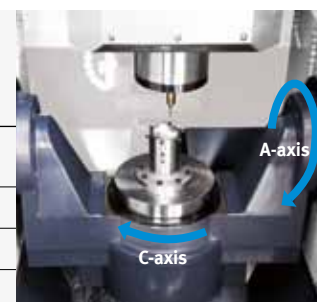
Description			FM 200/5AX linear	FM 350/5AX linear FM 400 linear
Rapid	X / Y / Z	m/min (ipm)	50 / 50 / 50 (1968.5 / 1968.5 / 1968.5)	80 / 80 / 80 (3149.6 / 3149.6 / 3149.6)
		m/sec <sup>2</sup>	14.7 / 14.7 / 14.7 [1.5G / 1.5G / 1.5G]	9.8 / 9.8 / 19.8 [1G / 1G / 2G]



## Rotary Axes Equipped with Direct Drive Motors\*

The rotary table is equipped with a direct drive motor for rapid rotation coupled with rapid acceleration and deceleration. Thermal error is minimized by the water cooling system.

Description		Unit	FM 200/5AX linear	FM 350/5AX linear
Rapid	A / C	r/min	100 / 200	50 / 100
Travel		deg	140 / 360	240 / 360
Load Capacity		kg (lb)	15 (33.1)	100 (220.5)

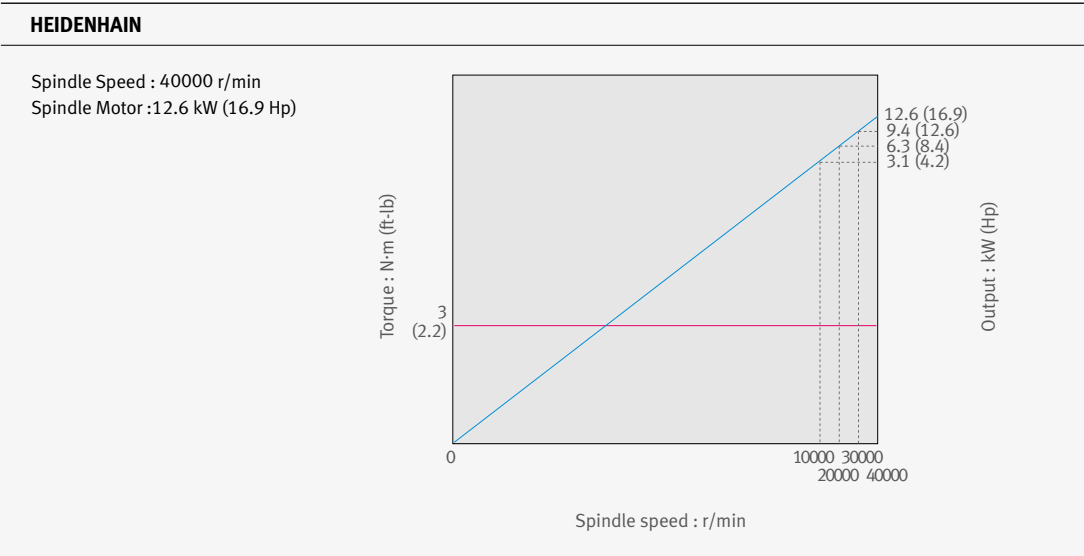


## Spindle

The spindle provides incomparably high productivity and machining accuracy.

### Ultra-high-speed Spindle

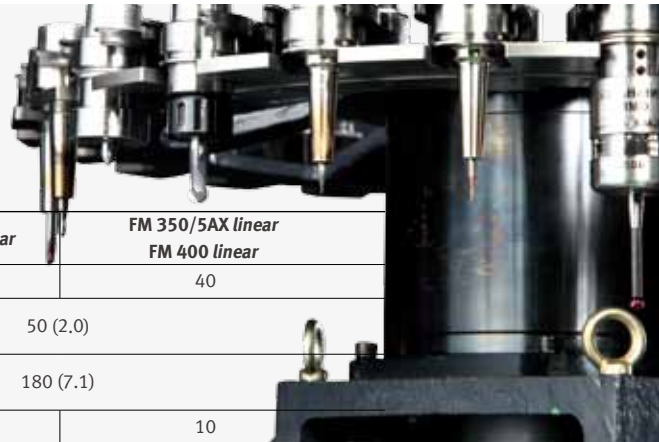
One of the highest-speed spindles in its class, the ultra-high-speed enhances productivity and machining accuracy.



## Magazine

The machine's structure has been simplified with the addition of a direct-drive motor, while the operator's convenience has been enhanced by manual magazine operation for tool storage.

### Tool Magazine



Description	Unit	FM 200/5AX linear	FM 350/5AX linear FM 400 linear
No.	ea	24	40
Max tool diameter	mm (inch)	50 (2.0)	
Max tool length	mm (inch)	180 (7.1)	
Tool change time	s	8	10

\* FM 200/5AX model





Standard / Optional  
Specifications

Diverse optional  
features are available  
for customer-specific  
requirements.

● Standard ○ Optional X N/A

NO.	Description	Features	FM 200/5AX linear	FM 350/5AX linear	FM 400 linear
1	Tool magazine	24 tools	●	X	X
2		40 tools	X	●	●
3	Tool shank type	HSK-E40	●	●	●
4	Auto door lock		●	●	●
5	Rotary table	Ø200	●	X	X
6		Ø350	X	●	X
7	Linear scale	X-axis	●	●	●
8		Y-axis	●	●	●
9		Z-axis	●	●	●
10	Spindle	40000 r/min	●	●	●
11		Spindle head cooling system	●	●	●
12		Thermal error compensation system	●	●	●
13	Spindle motor power	12.6 kW (HEIDENHAIN)	●	●	●
14	Auto tool measuring device	NT-2_BLUM	●	●	●
15	Auto work measuring device	OMP400_RENISHAW (W/Receiver)	○	○	○
16		OMI-2C_RENISHAW (Receiver Only)	○	○	○
17	Master tool for auto tool measurement	CALIBRATION TOOL_BLUM (HSK E40)	○	○	○
18	Auto power cut-off		○	○	○
19	Coolant	FLOOD (0.7kW_0.8MPa)	●	X	X
20		FLOOD (1.5 kW_0.69MPa)	X	●	●
21		SHOWER	○	○	○
22	Chip bucket		○	○	○
23	Chip conveyor	Chip pan	●	●	●
24		Hinged type	X	○	○
25		Drum type	○	X	X
26	Table	500 x 600 mm	X	X	●
27	Test bar		○	○	○
28	AIR	AIR BLOWER	●	●	●
29	MPG	Portable MPG	●	●	●
30	MQL		○	○	○
31	NC system	HEIDENHAIN iTNC530	●	●	●
32	OIL SKIMMER	BELT TYPE	○	X	X
33		TUBE TYPE	X	○	○

## Standard / Optional Specifications

Diverse options for enhanced work efficiency and operator convenience.

### Convenient operation panel

The ergonomically-designed Heidenhain operation panel and 19-inch large screen enhance the operator's convenience



### Tool length measurement device

The standard tool length laser measuring device secures the highest degree of accuracy even at super-high-speed operation. (The touch probe is optional.)



### Roller LMG

The roller-type LM Guideway has been adopted to ensure excellent rigidity and accuracy of the linear travel axes.



### Linear scale (standard for all axes)

All axes are equipped with the linear scale as a standard feature to maintain the highest degree of accuracy over many hours of operation.



### Gantry loader option

Information on detailed specifications required prior to ordering.



### OMP 400 option

FM 200/5AX implementation



## Recommendations for Machine Operation

Unlike ball-screw-type machines, a water chiller is used to cool down the linear motors and direct-drive motors. As such, the machine is sensitive to the control temperature of the chiller. Since the water chiller is controlled according to the ambient temperature, machine accuracy can be maintained and guaranteed in a constant temperature environment.

- Recommended operating conditions: Ambient temperature:  $20 \pm 1.5^{\circ}\text{C}$ , Temperature change:  $0.4^{\circ}\text{C/hr}$  or less,  $\pm 1.5^{\circ}\text{C/24hr}$ , Relative humidity: 20~80%

## Basic Information

Basic Structure  
Travel Axis

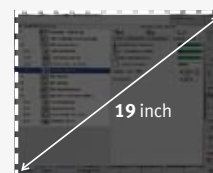
## Detailed Information

Options  
Capacity Diagram  
Specifications

## Customer Support Service



19" LCD



19 inch

Description	HEIDENHAIN iTNC530	Remarks
Screen size	19" LCD	-
Storage memory	144GB	-
Interference prevention system	Optional	-
Kinematic OPT.	Standard	Measuring device not included
Look-ahead block	1024 blocks	-
3D line graphics	Standard	-

## Convenient Features

**Data are controlled in the folder structure; convenient communication enabled by USB devices.**



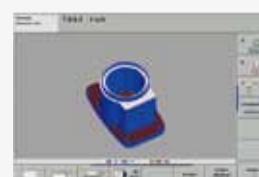
**Various built-in pattern cycles for a wider scope of application.**

Tool length, diameter and work pieces are measured using stored tool measurement graphic cycles.



**Graphic simulation**

Before starting the actual cutting process, graphic process simulation of the NC program can be carried out using TEST RUN. The cutting time can be estimated.



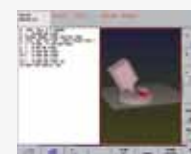
**Kinematic Opt (rotary axes center correction)**

The interactively (graphically) supported fixed cycle enables easy measurement of the centers of the rotary axes.



**Collision Protection System** option

The motion of the machine can be simulated on a 3D basis to substantially prevent mechanical interference. (Tool length is also recognized.)



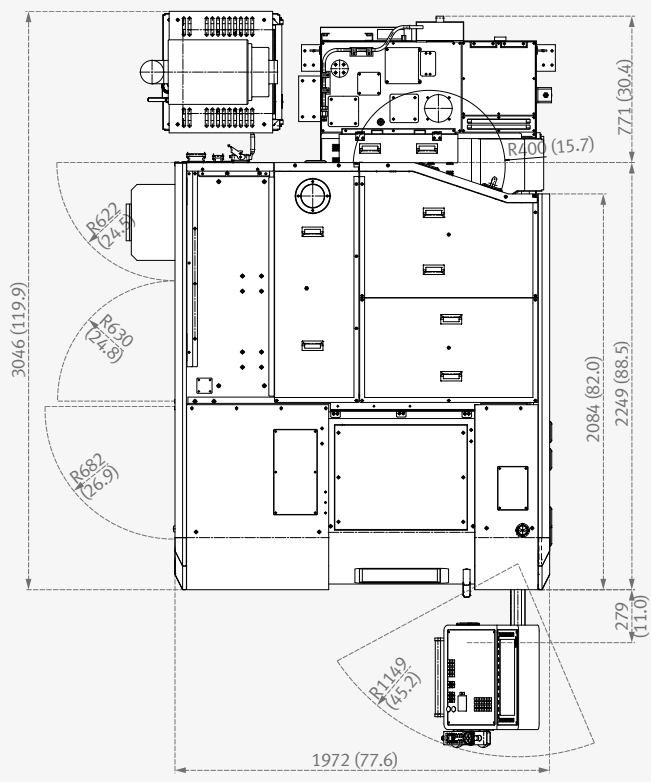


External Dimensions

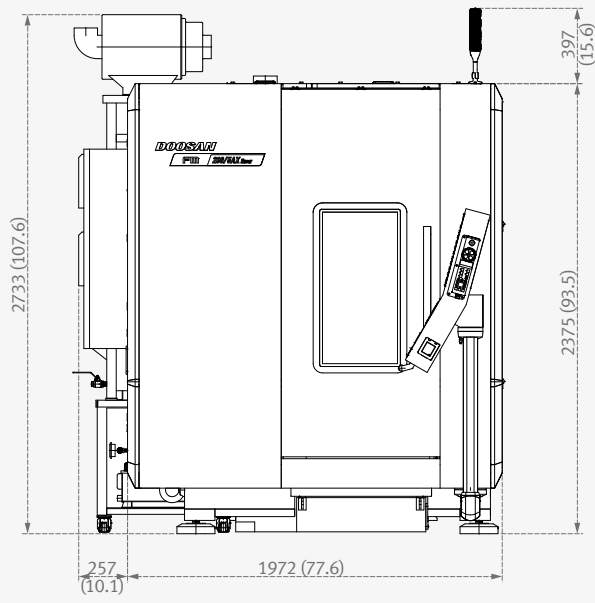
FM 200/5AX linear

Unit: mm (inch)

Top View



Front View

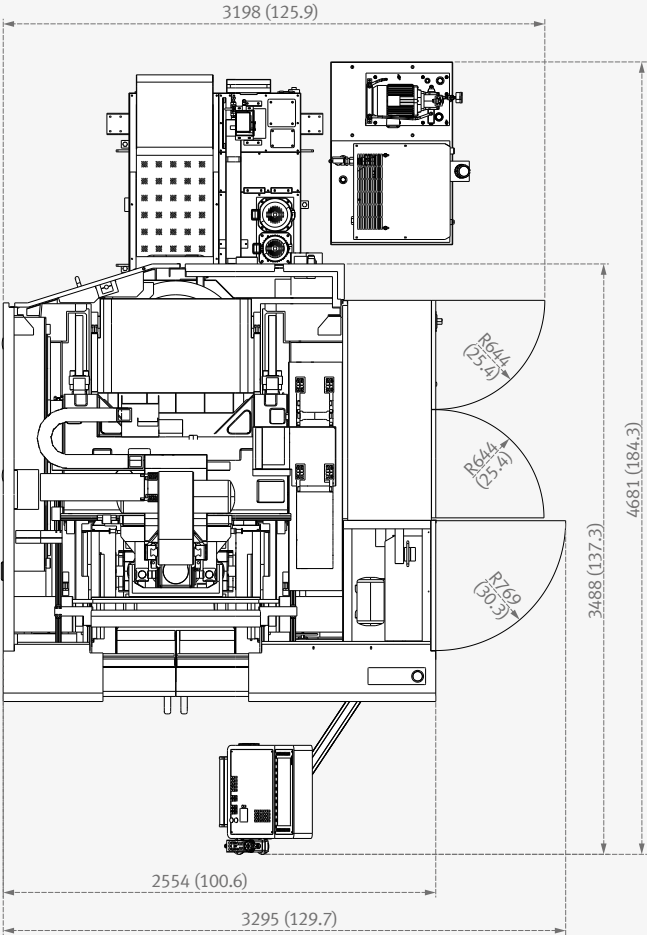


External Dimensions

FM 400 linear  
FM 350/5AX linear

Unit: mm (inch)

Top View



Front View

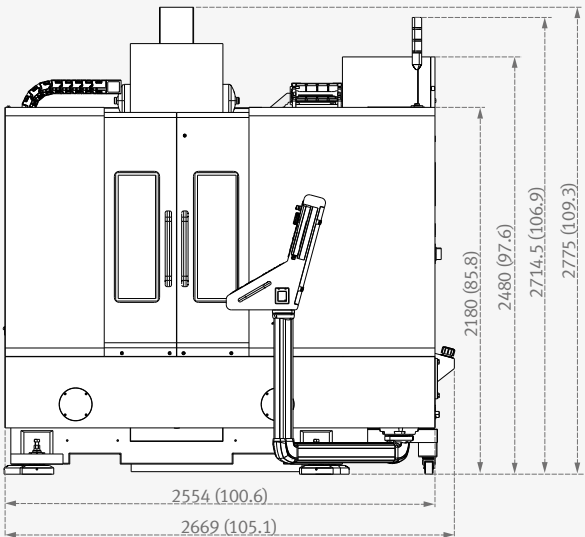
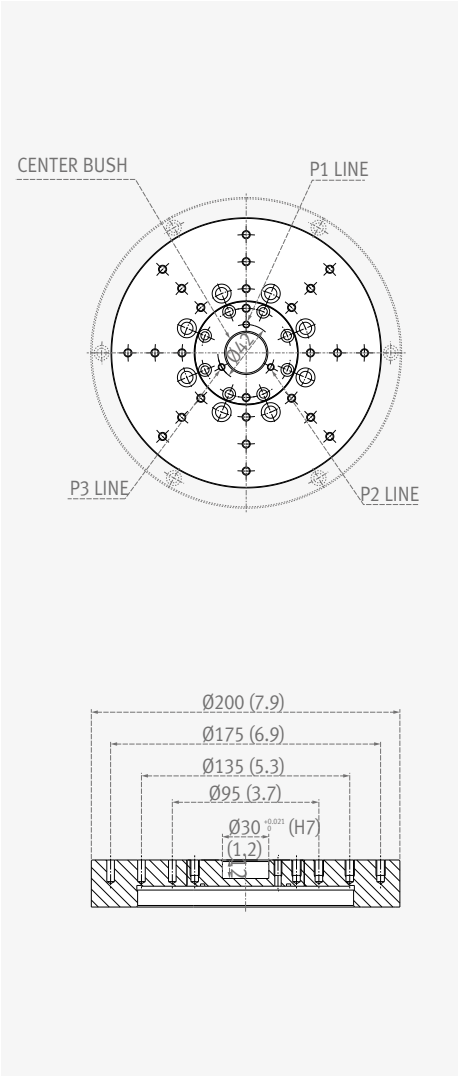


Table / Tool Shank

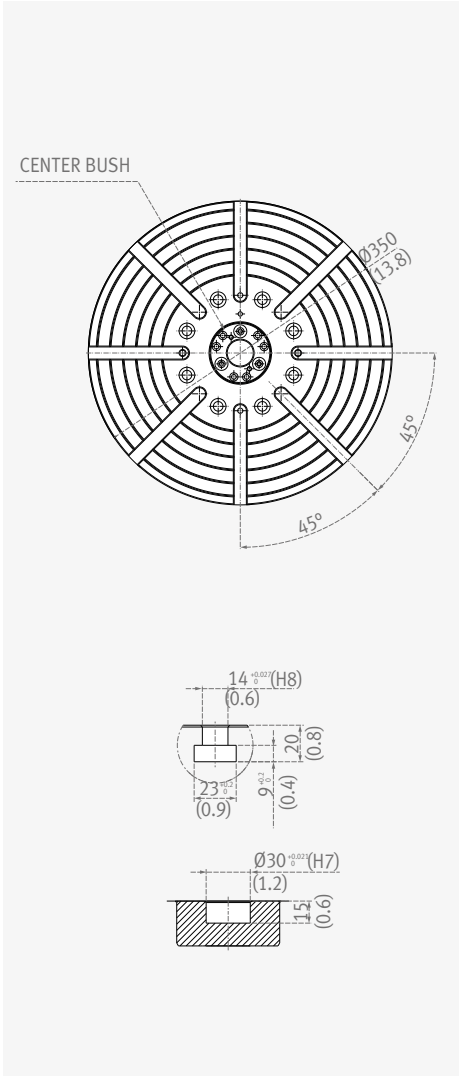
Table

Unit: mm (inch)

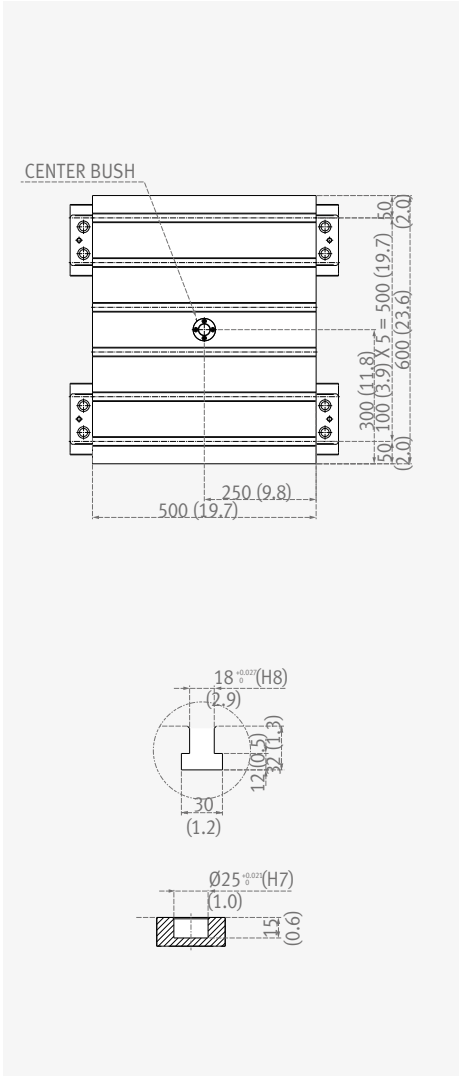
FM 200/5AX linear



FM 350/5AX linear



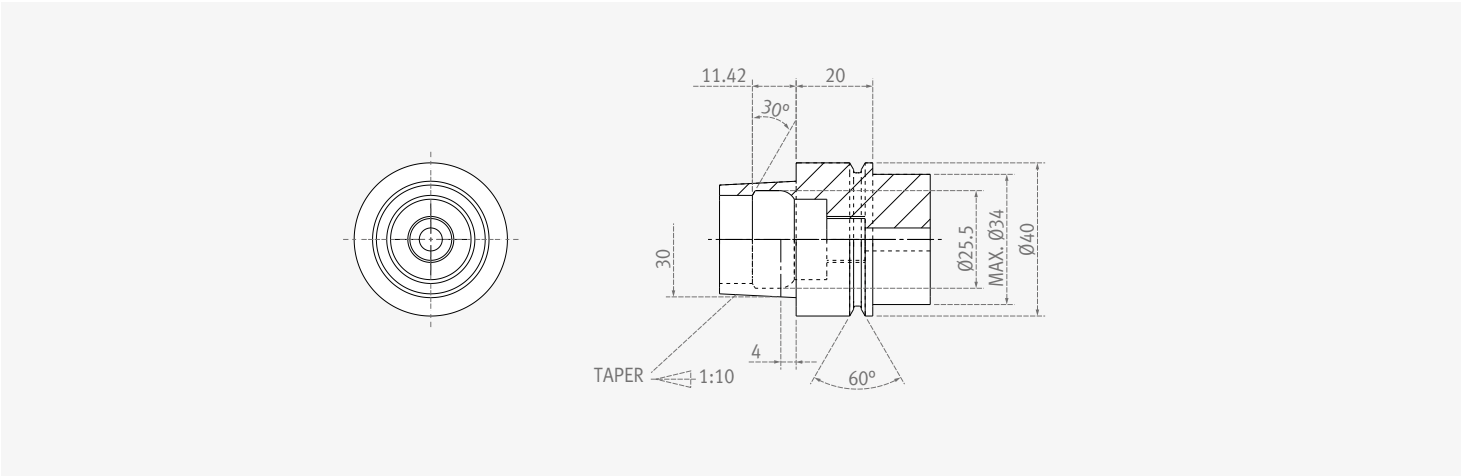
FM 400 linear



Tool Shank

Unit: mm (inch)

HSK E40



Basic Information

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Capacity Diagram  
Specifications

Customer Support Service

Machine Specifications



Description			Unit	FM 200/5AX linear	FM 350/5AX linear	FM 400 linear
Travel	Travel distance	X-axis	mm (inch)	200 (7.9)	400 (15.7)	
		Y-axis	mm (inch)	340 (13.4)	600 (23.6)	
		Z-axis	mm (inch)	300 (11.8)	350 (13.8)	
		A-axis	deg	140 ( -10 ~ +130 )	240	-
		C-axis	deg	360		-
	Distance from spindle center to table top		mm (inch)	110~410 (4.3~16.1)	50~400 (2.0~15.7)	150~500 (5.9~19.7)
	Distance from spindle center to column		mm (inch)	230 (9.1)	300 (11.8)	
Feed rate	Rapid traverse rate	X-axis	m/min (ipm)	50 (1968.5)	80 (3149.6)	
		Y-axis	m/min (ipm)	50 (1968.5)	80 (3149.6)	
		Z-axis	m/min (ipm)	50 (1968.5)	80 (3149.6)	
		A-axis	r/min	100	50	-
		C-axis	r/min	200	100	-
	Cutting feed rate		m/min (ipm)	20 (787.4)	30 (1181.1)	30 (1181.1)
Table	Table size		mm (inch)	ø 200 (ø 7.9)	ø 350 (ø 13.8)	500 x 600 (19.7 x 23.6)
	Loading capacity		kg (lb)	15 (33.1)	100 (220.5)	600 (1322.8)
Spindle	Max. spindle speed		r/min	40000		
	Spindle taper		-	HSK E40		
	Max. spindle torque		N·m (ft·lb)	3 (2.2)		
Automatic tool changer	Tool shank type		-	HSK E40		
	Tool storage capacity		ea	24	40	
	Max tool diameter		mm (inch)	50 (2.0)		
	Max. tool length		mm (inch)	180 (2.9)		
	Max. tool weight		kg (lb)	1 (2.2)		
	Tool selection		-	FIXED		
	Tool change time (tool to tool)		s	8	10	
	Tool change time (chip to chip)		s	10	13	
Motor	Spindle motor power		kW (Hp)	12.6 (16.9)		
	Coolant pump motor power		kW (Hp)	0.7 (0.9)	1.5 (2.0)	
Power Source	Power consumption		kVA	66.4	88.3	63.5
	Compressed air pressure		MPa (psi)	0.54 (78.3)		
Tank Capacity	Coolant tank capacity		L	310	300	
	Lubricant tank capacity		L	5		
Tank Capacity	Height		mm (inch)	2375 (93.5)	2775 (109.3)	
	Length		mm (inch)	2249 (88.5)	2585 (101.8)	
	Width		mm (inch)	1972 (77.6)	2669 (105.1)	
	Weight		kg (lb)	6800 (14991.2)	12000 (26455.1)	
Controller			-	HEIDENHAIN iTNC 530		

Recommended operating conditions: Ambient temperature: 20 ± 1.5°C  
Temperature change: < 0.4°C/h < ±1.5°C/24h  
Relative humidity: 20~80%

# HEIDENHAIN

## iTNC 530

### AXES CONTROL

- Controlled axes	X, Y, Z, C, A 5 axes
- Simultaneously controllable axes	
- Positioning / Linear interpolation 5 axes	
- Circular interpolation 2 axes	
- Helical interpolation 5 axes	
- Feedrate override	0 - 150 %
- Least command increment	0.0001 mm (0.0001 inch)
- Least input increment	0.0001 mm (0.0001 inch)
- Maximum commandable value	±99999.999mm (±3937 inch)
- Pulse handle feed Portable manual pulse generator	
- Machine Model : FM400 linear / FM 350 / 5AX linear	
- Portable manual pulse generator	
- Linear / non-linear axis error, backlash	
- Reversal spikes during circular movement	
- Offset, thermal expansion, stiction, sliding friction	

### SPINDLE FUNCTION

- Spindle orientation	
- Spindle speed command	S5 digits
- Spindle speed override	0 - 150 %

### TOOL FUNCTION

- 3-dimensional tool compensation	
- Number of tool offsets	999 ea
- Tool length compensation	
- Tool management (tool table)	
- Tool management (tool table)	Tool numbers and names
- Tool management (tool table)	Tool length L and tool radius R
- Tool management (tool table)	Tool life management & replacement tool
- Tool number command	
- Tool radius compensation	

### PROGRAMMING & EDITING FUNCTION

- Background editing	
- Heidenhain conversational format programming	
- Program memory	Hard disk with 26GB for NC programs No limit on number of programs
- 3-D touch probe application	
- Touch probe functions for compensating workpiece misalignment	
- Touch probe functions for setting data	
- Touch probe functions for automatic workpiece measurement	
- Block processing time	0.5 m [s]
- Contour elements	
- Straight line, chamfer, circular arc, circle center, circle radius	
- Corner rounding, tangentially connecting circle, B spline	
- Coordinate transformation	
- Coordinate shift, coordinate rotation	

Mirror image, scaling

Tilting the working plane

- Data interface RS - 232C / Ethernet (100Base T)

- Fixed cycle (canned cycle)

Machine Model : FM400 linear

Drilling cycle

(drilling, pecking, reaming, boring, tapping, rigid tapping)

Milling, finishing rectangular, circular pockets

Linear and circular hole patterns

Linear and circular hole patterns

Milling pockets and islands

Cylindrical surface interpolation

- FK free contour programming

- Mathematical functions

+, -, x, ÷, √, sin, cos, tan, arcsin, arccos, arctan

Logical comparison (=, ≠, &lt;, &gt;, ≤, ≥)

- Program jumps

Subprograms, program section repeats

- Programming support

Functions for approaching / departing the contour

On- screen pocket calculator, structuring of programs

- Kinematic OPT

- Kinematic COMP

- Dynamic Collision Monitoring

### GRAPHIC FUNCTIONS

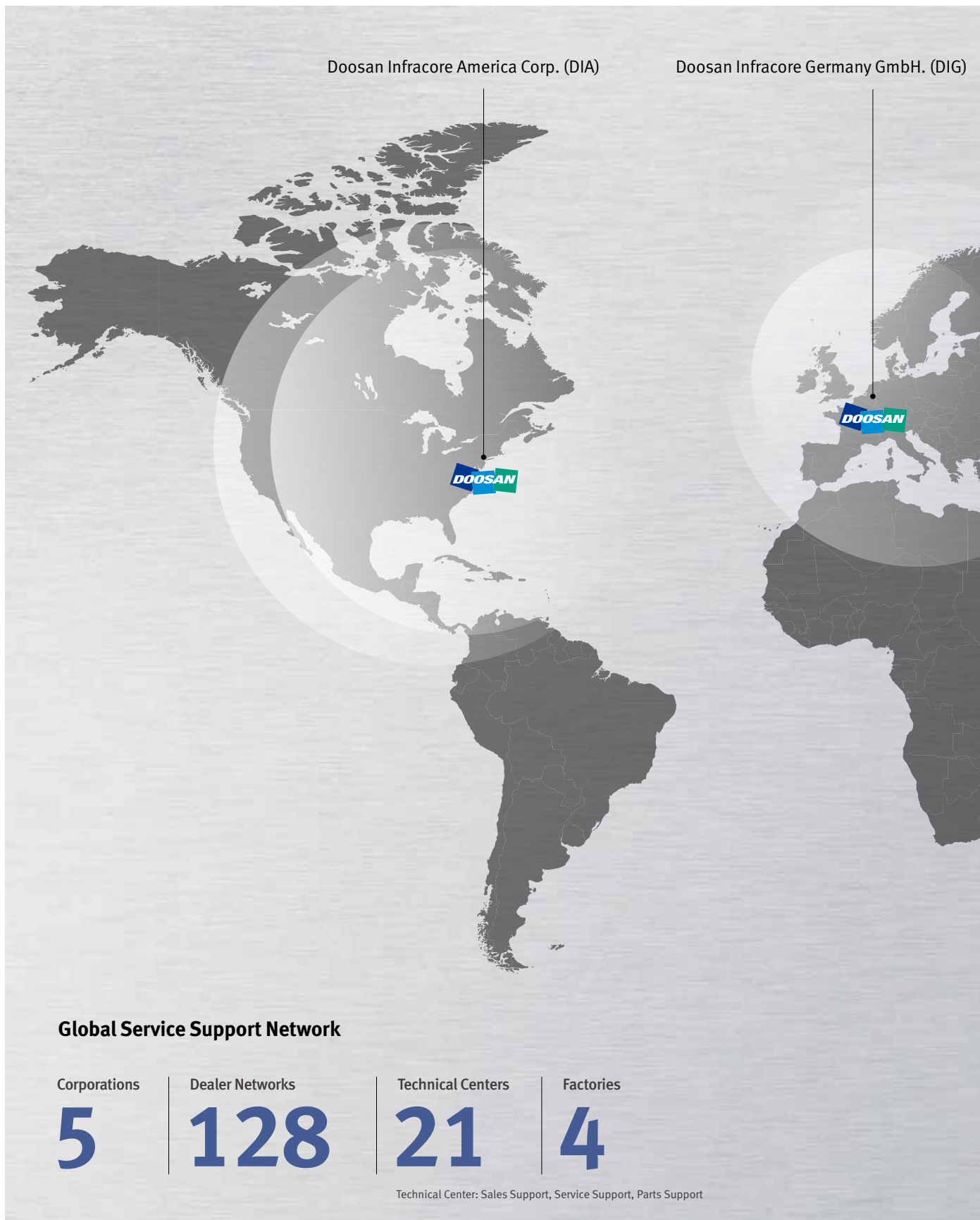
- Graphic display	
- Interactive programming graphics	
- Test run graphics (3-D representation)	
- Program run graphics (3-D representation)	
- MDI / CRT unit	19" TFT color flat panel

### OPTIONAL SPECIFICATIONS

- Controlled axes	Max. 12 axes in total
- Digitizing with 3-D triggering touch probe	
- Digitizing with 3-D measuring touch probe	

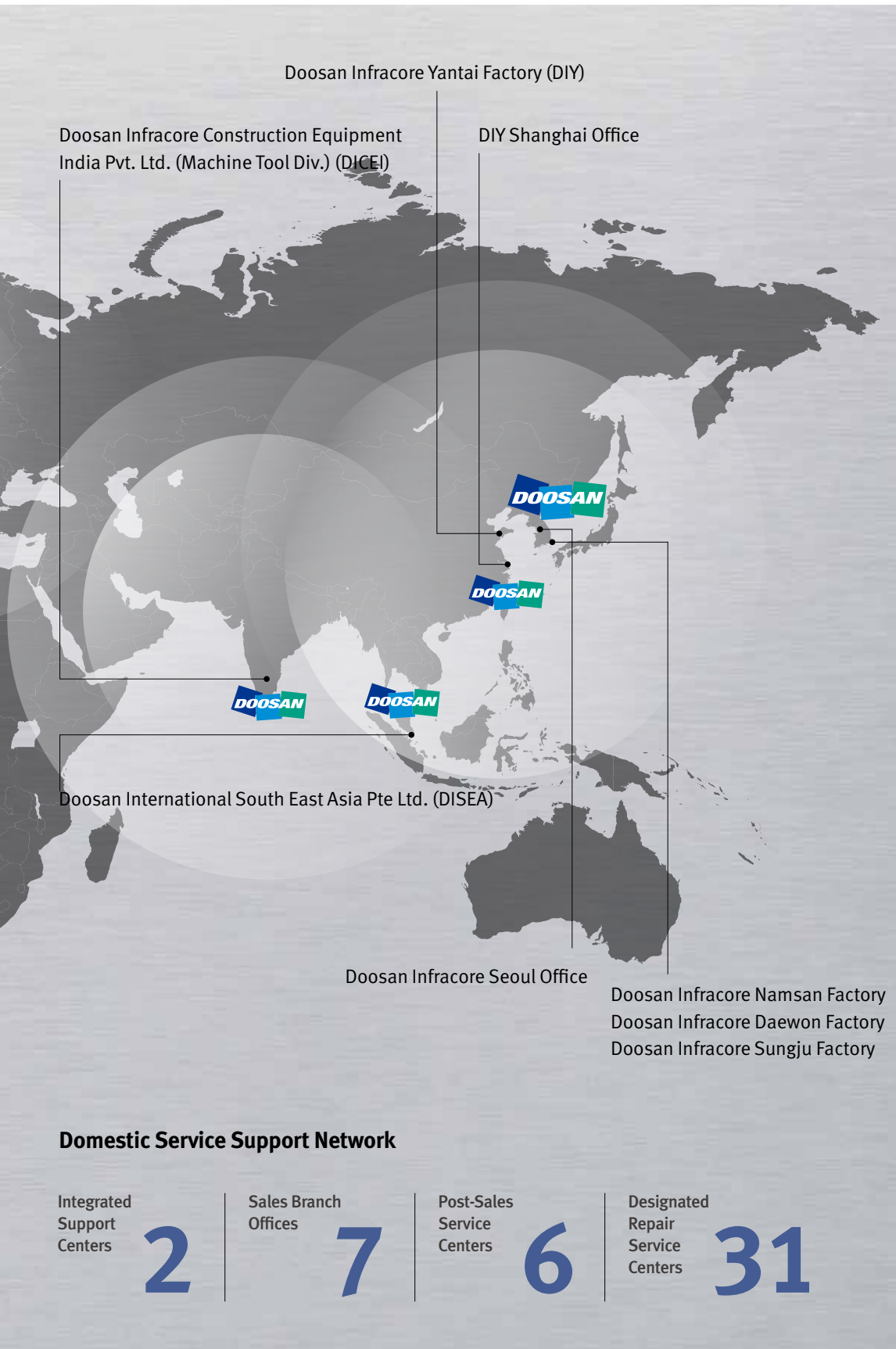


# Responding to Customers Anytime, Anywhere



## Doosan Machine Tools' Global Network, Responding to Customer's Needs nearby, Anytime, Anywhere

Doosan machine tools provides a system-based professional support service before and after the machine tool sale by responding quickly and efficiently to customers' demands. By supplying spare parts, product training, field service and technical support, we can provide top class support to our customers around the world.



## Customer Support Service

We help customers to achieve success by providing a variety of professional services from pre-sales consultancy to post-sales support.

### Supplying Parts



- Supplying a wide range of original Doosan spare parts
- Parts repair service

### Field Services



- On site service
- Machine installation and testing
- Scheduled preventive maintenance
- Machine repair

### Technical Support



- Supports machining methods and technology
- Responds to technical queries
- Provides technical consultancy

### Training



- Programming / machine setup and operation
- Electrical and mechanical maintenance
- Applications engineering

## FM linear series



Description	UNIT	FM 200/5AX linear	FM 350/5AX linear	FM 400 linear
Max. spindle speed	r/min	40000		
Motor power	kW (Hp)	12.6 (16.9)		
Tool taper	taper	HSK E 40		
Travel distance (X / Y / Z)	mm (inch)	200 / 340 / 300 (7.9 / 13.4 / 11.8)	400 / 600 / 350 (15.7 / 23.6 / 13.8)	
Tool storage capacity	ea	24	40	
Table size	mm (inch)	Ø 200 (Ø 7.9)	Ø 350 (Ø 13.8)	500 x 600 (19.7 x 23.6)
Table tilting / rotation angle (A / C)	deg	140 / 360	240 / 360	-
NC system	-	HEIDENHAIN		



## Doosan Machine Tools

<http://www.doosanmachinetools.com>

### Optimal Solutions for the Future

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\* For more details, please contact Doosan.

\* The specifications and information above-mentioned may be changed without prior notice.